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REVISION OF THE GENUS *DIDYMOCYSTIS* AND VALIDATION OF THE GENUS *DIDYMOSULCUS* GEN. N. (TREMATODA, DIDYMOZOIDAE)

By S.E. Pozdnyakov

As the result of the revision of the genus *Didymocystis* Ariola, 1902, all species having a median sulcus on the posterior part of the body have been removed from its volume. For them, the genus *Didymosulcus* gen. n. has been validated. The genera *Coeliodidymocystis*, *Didymocystoides* and *Univitellodidymocystis*, which have been described by Yamaguti (1970) have been reduced to synonyms of the genus *Didymocystis*.

The genus *Didymocystis* was validated by Ariola (1902), for the species *D. reniformis* which he described. Among the synonyms of *D. reniformis*, Ariola lists *Monostoma bipartitum* (forma 2) Wagener, 1858 and *Didymozoon thynii* Taschenberg, 1879, which were previously established in the volume of other genera. Yamaguti (1934) reports finding the species *D. reniformis* in tuna in the Pacific Ocean. One would expect that Yamaguti (1934) would correct the deficiencies in Ariola's description of this species, but instead he does not give a detailed description or drawings, and limits himself to brief comments of a general nature. Later Ishii (1935) and Yamaguti (1958, 1971) were able to spot in the species *Didymozoon thynni* which was described in a few lines and had no drawing, a similarity with the species *Didymocystis reniformis* and considered the latter to be a synonym of the former. On the basis of the articles of the lInternational Codex of Zoological Nomenclature (ICZN, 1988) 68(1), the type species should have the name *Didymocystis reniformis* Ariola, 1902. The species *Didymozoon thynni* should be considered a *species inquirenda*, since on the whole it is difficult to assign it to any of the genera of the Didymozoidae due to the

unsatisfactory description. The ICZN generally does not recommend that poorly described species, especially those without drawings, be used as type species (article 69 A). Turning once again to the species of the genus *Didymocystis* described by Ariola (*D. reniformis, D. wedli*), it is not hard to see that the structure of the posterior part of these worms differs substantially. The shape of the body in *D. reniformis* corresponds entirely to that of the species of the genera *Coeliodidymocystoides, Didymocystoides, Univitellodidymocystis*, which were established by Yamaguti (1970). The posterior part of the body in these worms is hemispherical and has a more or less prounounced patelliform concavity on the flattened surface. At the sime time, for *D. wedli*, Ariola indicates quite unambiguously that the anterior portion of the posterior part of the body is divided into two equal lobes by a rather deep median sulcus and confirms this with appropriate drawings (Ariola, 1902; Fig. 8, 9). Considering that the genus *Didymocystis* has been validated for the species *D. reniformis*, whose structure is identical to the species of the three above-mentioned genera, established by Yamaguti (1970), the latter must be recognized as synonyms of the genus *Didymocystis*. The forms which have a more or less developed median sulcus, which begins on the convex side of the posterior part of the body and extends onto the concave side, so that the anterior portion of the posterior part of the body becomes bilobate, should be removed from the volume of the genus *Didymocystis* and combined in a new genus - *Didymosulcus* gen. n.

Didymocystis Ariola, 1902, emend.

Syn. *Coeliodidymocystis, Didymocystoides, Univitellodidymocystis.*

D i a g n o s i s. Didmyozoidae: Didymozoinae. Hermaphrodites, enclosed in pairs in capsules. The body is clearly divided into two parts. The anterior part of the body is thin, elongated, sometimes broadened in the anterior third

of its length. The posterior part of the body is hemispherical. There is a calyciform concavity of greater or lesser magnitude on its flattened side. The anterior part of the body merges with the posterior part close to the anterior end of the posterior part of the body. An oral sucker and a pharynx are present. The intestinal branches run through both parts and terminate at the end of the posterior part of the body. Two unbranched testicles are situated in the posterior part of the body. The ovary and the yolk gland are branched or not. A spermatheca is present. The uterus forms numerous loops in the posterior part of the body. In the anterior part, it forms a metraterm, which merges at the distal end with the ejaculatory duct, forming a hermaphrodite duct. The genital opening opens ventrally or latero-ventrally of the pharynx. Parasites of marine fishes, predominately Scombroidei suborder.

Type species - *Didymocystis reniformis* Ariola, 1902.

Also included in the composition of the genus: *D. scomberomori* (G.A. et W.G. MacCallum, 1916) comb. n., *D. acanthocybii* Yamaguti, 1934, *D. alolongae* Yamaguti, 1938, *D. opercularis* Yamaguti, 1938, *D. semiglobularis* Ishii, 1935, *D. submentalis* Yamaguti, 1938, *D. singularis* (Job, 1966) comb. n., *D. buccalis* (Yamaguti, 1970) comb. n., *D. exiguus* (Yamaguti, 1970) comb. n., *D. intestinomuscularis* (Yamaguti, 1970) comb. n., *D. oesophagicola* (Yamaguti, 1970) comb. n., *D. pectoralis* (Yamaguti, 1970) comb. n., *D. pinnicola* (Yamaguti, 1970) comb. n., *D. bifasciatus* (Yamaguti, 1970) comb. n., *D. sphyraenae* (Hussain, Hanumantharao et Shyamasundari, 1985 b) comb. n., *D. visakhapatnamensis* (Hussain, Hanumantharao et Shyamasundari, 1985 b) comb. n.

Didymosulcus Pozdnyakov, gen. n.

D i a g n o s i s. Didymozoidae : Didymozoinae. Hermaphrodites, enclosed in pairs in capsules or resting freely in the tissues of the host. The body is

clearly divided into two parts. The anterior part is thin, elongated. It may constrict conically from the base to the oral sucker or may be of relatively uniform thickness. The posterior part is very broadened and has a complex structure. In its anterior portion, it is divided to a greater or lesser degree by a median sulcus into two equal lateral lobes. The posterior part of the body gradually constricts, becomes conical and curls more or less markedly onto the ventral side; sometimes the constricted portion of the posterior part does not curl onto the ventral side. The base of the anterior part of the body is situated closer to the bilobate portion of the posterior part of the body. An oral sucker and a pharynx are present. Sometimes the pharynx is absent. The esophagus is relatively long. The intestinal branches run through both parts of the body. Mucus-secreting cells around the esophagus and the beginning of the intestinal trunks may be present or absent. There are two testicles. They are situated one in each of the lateral lobes. The ovary is elongated, long, branched or not. The yolk gland is elongated, branched or not. A spermatheca may be present or absent. The uterus forms numerous loops in the posterior part of the body. On transition to the anterior part of the body, it forms a well developed metraterm. The distal end of the metraterm merges with the ejaculatory duct, forming a hermaphrodite duct, which, running through the genital papillae, opens up by the genital opening at the level of the pharynx or the oral sucker. Parasites of tissues of fishes of Scombroidei suborder.

Type species - *Didymosulcus katsuwonicola* (Okada, 1926) comb. n.

Of the old species, the morphology and antaomy of *Wedlia katsuwonicola* Okada, 1926 have been most fully described. The only serious mistake in Okada's description is that he took the thick testicles situated in the antero-dorsal lobes for an ovary. Ishii (1935) made a detailed redescription of this species,

correcting Okada's mistake. We have thefore selected the oldest of the well described species as the type species.

In addition to the type species, the volume of the genus includesl the following species: *D. lanceolata* (Guiart, 1938) comb. n., *D. macroorchis* (Guiart, 1938) comb. n., *D. bifurcata* (Yamaguti, 1970) comb. n., *D. irregularis* (Yamaguti, 1970) comb. n., *D. nasalis* (Yamaguti, 1970) comb. n., *D. orbitalis* (Yamaguti, 1970) comb. n., *D. palati* (Yamaguti, 1970) comb. n., *D. philobranchia* (Yamaguti, 1970) comb. n., *D. philobranchiarca* (Yamaguti, 1970) comb. n., *D. poonui* (Yamaguti, 1970) comb. n., *D. spirocauds* (Yamaguti, 1970) comb. n., *D. superpalati* (Yamaguti, 1970 comb. n., *D. rotunditestis* (Nikolaeva et Dubina, 1985) comb. n. Also included in the volume of the genus are the new species whose description is given below: *D. aahi* sp. n. and *D. dimidiatus* sp. n. Transferred to the category of *species inquirendae* are: *D. wedli* Ariola, 1902, due to the unsatisfactory description of the internal structure; *D. bilobata* Ishii, 1935, to establish the genus affiliation of this trematode is difficult due to the vague description allowing different interpretations of the peculiarties of the external and internal structure; *D. soleiformis* Ishii, 1935, for the same reasons as the preceding species.

Didymosulcus katswonicola (Okada, 1926) comb. n.
(Fig. 1)

Syn. *Wedlia katsuwonicola* Okada, 1926; *Didymocystis katsuwonicola* (Okada, 1926) Ishii, 1935; *D. wedli* - Yamaguti, 1934, nec Ariola, 1902.

M a t e r i a l. More than 100 specimens. Host: *Thunnus obesus, T. albacares.* Localization: gill arches. Region found: northwestern tropical and subtropical parts of the Pacific Ocean.

D e s c r i p t i o n. Body divided into two parts. The anterior part of the body is elongated, thin, cylindrical in section. Its length is 0.7 – 0.9[1].

[1]All measurements are cited in millimeters.

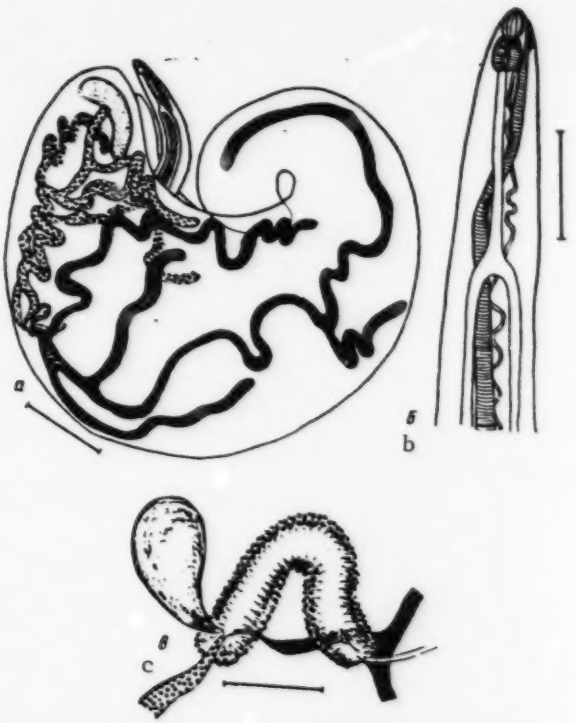

Fig. 1. ***Didymozoulcus katsuwonicola*** **Okada, 1926) comb. n.: *a* - overall view, *b* - anterior part of body, *c* - central part of female reproductive system. Scale (mm): *a* - 0.5; *b,c* - 0.1.**

The posterior part of the body measuring 2.2 - 3.4 is bent in the form of a horseshoe, very broadened at the front and constricting gradually towards the caudal end. The median sulcus is well developed. It begins on the convex side of the posterior part of the body and crosses onto the concave side, reaching almost to the caudal end. The oral sucker has dimensions 0.028 - 0.035 X 0.02 - 0.028. The pharynx is spherical, 0.026 - 0.033 in diameter. The esophagus is long, thin. The intestinal branches in the anterior part of the body are thin; they broaden in the posterior part and extend to the caudal end. The testicles are elongated, and are situated in the lateral lobes before the section of

transition of the anterior part of the body to the posterior part. The deferent ducts are long and thin. They merge at the boundary of the anterior and posterior parts, forming the ejaculatory duct, which passing through the anterior part of the body opens into a short hermaphrodite duct. The ovary and yolk gland are branched. The branches of the ovary 0.1 - 0.15 wide are situated on the periphery of the anterior half, while the branches of the yolk gland occupy the central and posterior portions of the posterior part of the body. The width of the yolk gland is 0.04 - 0.06. The central part of the female reproductive system is situated much lower than the median sulcus. The spermatheca is pyriform 0.15 - 0.17 X 0.08 - 0.1. The uterus forms numerous loops. At the boundary of the anterior and posterior parts of the body it forms a metraterm, the distal end of which merges with the ejaculatory duct, forming a short hermaphrodite duct. The genital opening is situated medio - ventrally of the oral sucker. The eggs are small (0.015 - 0.017 X 0.01), numerous. The excretory vesicle occupes a central position in the posterior part of the body.

Didymosulcus aahi Pozdnyakov, sp. n.
(Fig. 2)

M a t e r i a l: 103 specimens. Host: *Thunnus alalunga, T. albacares.* Localization: gill rakers. Region found: waters of southwestern part of Pacific Ocean. Vanuatu.

Holotype HT 89002 and paratypes PT 89003 - 89005 are kept at the Laboratory of Parasitology of Marine Animals of the Pacific Ocean Scientific Research Institute of Fisheries and Oceanography (TINRO).

D e s c r i p t i o n. The body is divided into two parts. The anterior part is thin, long, cylindrical, rounded in section, constricting towards the

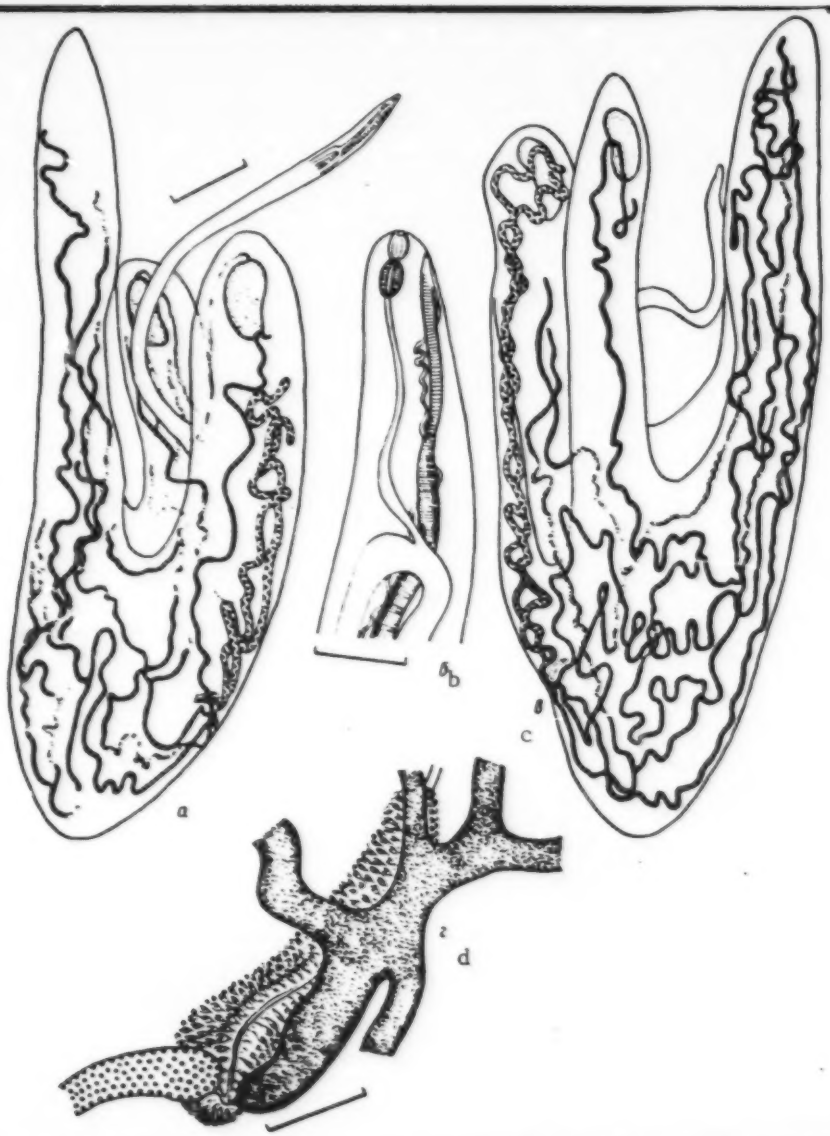

Fig. 2. *Didymosulcus ashi* **sp. n.:** *a* **- general view, holotype;** *b* **- anterior part of body;** *c* **- general view, paratype from side of median sulcus on ventral side of the body;** *d* **- central part of female reproductive system. Scale (mm):** *a*, *c* **- 1; b - 0.05;** *d* **- 0.1.**

anterior end. Its length is 5.48 (2.72 - 7.00)[1], width 0.078 (0.067 - 0.089). The posterior part of the body is broadened, constricting gradually to the posterior

[1]The dimensions of the paratypes are given in the brackets.

end. The median sulcus, which begins on the convex side of the posterior part of the body, divides its front portion into two narrow lobes and turns towards the inner (concave) side, forming a small depression, which falls short of the caudal end by a third of the length. The oral sucker is terminal, 0.016 X 0.22 (0.01 - 0.018 X 0.016 - 0.03) in size. The pharynx measures 0.01 X 0.01 (0.01 X 0.01 - 0.22). The esophagus is relatively short. The intestinal branches are long, thin, and sometimes reach the posterior end of the posterior part of the body. The testicles are bean-shaped; they are situated in the lateral lobes of the anterior end of the posterior part of the body. The long deferent ducts issue forth from them and wind toward the boundary of the anterior and posterior parts of the body, where they merge forming the enjaculatory duct. The latter runs the length of the anterior part and merges with the metraterm at the distal end forming a hermaphrodite duct, which opens in the genital opening. The ovary is biramous. Both of its branches are situated in one of the lateral lobes of the anterior portion of the posterior part of the body. The width of the ovary is uniform for its entire length - 0.039 (0.028 - 0.039). The spermatheca is absent. The central part of the female reproductive system is situated at a short distance from the base of the median sulcus on the convex side of lthe posterior part of the body. The Mehlis' gland is compact. The yolk gland is very branched. The number of second and third order branches varies greatly. Most often, one or two of the main branches is directed towards the lateral lobes, with the greatest number of ramifications occuring on the lobe which does not contain the ovary. Another two or three main branches are directed towards the posterior end of the posterior part of the body, occupying a predominately peripheral region along the convex side of the posterior part. The second and third order branches run from the main branches. The width

of the yolk gland is 0.028 (0.01 - 0.028). The uterus forms numerous loops in the posterior part of the body. The uterus forms a muscular metraterm at the boundary of the anterior and posterior parts of the body. The metraterm runs the entire length of the anterior part and merges at the end with the ejaculatory duct. The eggs have dimensions 0.011 X 0.016.

D i f f e r e n t i a l d i a g n o s i s. The described species differs from the previously known ones in the body shape and topography of the internal organs. The anterior part of the body is very long, the posterior part very curled. The ovary is always directed only forward into one of the lateral lobes.

Didymosulcus dimidiatus Pozdnyakov, sp. n.
(Fig. 3)

M a t e r i a l: 136 specimens. Host: *Thunnus alalunga*. Localization: upper palate. Region found: southern subtropical part of the Pacific Ocean.

The Holotype HT 89003 and paratypes PT 89006 - 89010 are kept at the Laboratory of Parasitology of Marine Animals of the Pacific Ocean Scientific Research Institute of Fisheries and Oceanography.

D e s c r i p t i o n. Two individuals, oriented with respect to each other, are situated in the tissues of the upper palate without capsule. In live form, the worms are of bright yellow color. Their body is divided into two parts. The anterior part is quite long, conical, rounded in section. Its length is 0.873 (0.67 - 0.97). The width in the middle part is 0.112 (0.1 - 0.13). The oral sucker is terminal, 0.045 X 0.028 (0.039 - 0.045 X 0.022). The pharynx is well developed, muscular, measuring 0.022 X 0.022 (0.01 - 0.022 X 0.016 - 0.022). The esophagus is very short. The intestinal trunks issue from it and and extend almost to the posterior part of the body. In the anterior part of the body, the intestinal

Fig. 3. *Didymoculcus dinidatus* sp. n.: *a* - general view, 1b - position of individuals in capsule; *c* - complementariness of the posterior parts of the body of the two individuals in the capsule; *d* - central part of female reproductive system; *e* - anterior part of the body. Scale (mm) : *a* - 0.25; *d,e* - 0.1.

trunks are thin; they bend sharply on crossing into the posterior part and extend along its concave side, their thickness varying over the length. The posterior part of the body is broadened and sharply curled at the anterior and posterior ends. The median sulcus is very deep. It begins at the level of the middle of the convex surface of the posterior part of the body and divides the anterior half of this part into two clearly delimited lateral lobes. The median sulcus then crosses onto the inner (concave) side and extends in the form of a shallow notch almost to the end of the posterior part of the body. The length of the posterior part is 2.66 (2.44 - 3.07), width 0.31 (0.29 - 0.35). The testicles are elongated, curled in a C-shape and situated at the anterior margin of the very recurved lateral lobes. The width of the testicles is 0.039 (0.033 - 0.058). The deferent ducts are very long. They merge at the boundary of the anterior and posterior parts of the body, forming the ejaculatory duct, which crosses the anterior part and merges at the end with the metraterm, forming the short hermaphrodite duct, which terminates in the genital opening. The latter is surrounded by small papillae. The ovary is biramous, without secondary ramifications. One of its branches is directed towards the right lateral lobe, the other towards the left one. The width of the ovary is uniform for its entire length 0.033 (0.033 - 0.045). The central part of the female reproductive system is situated at the base of the median sulcus on the convex side of the posterior part of the body. The spermatheca is absent. The Mehlis' body is small and compact. The yolk gland is branched. There are usually three, less often four, main branches. Second order and less often third order branches run from them. Two of the main branches are directed forward, one into each of the lateral lobes. The third branch runs backwards, reaching the posterior end of the body. If there are four branches of the yolk gland, then two of them are

directed backwards. The width of the branches of the yolk gland is 0.022 (0.022 - 0.039). The uterus forms a small number of loops. The uterus forms a metraterm at the base of the anterior part of the body. The metraterms merges at its distal end with the ejaculatory duct, forming the hermaphrodite duct. The eggs have dimensions 0.016 X 0.005.

D i f f e r e n t i a l d i a g n o s i s. It differs from the previously known species of *D. dimidiatus* sp. n. in the body shape and the topography of the internal organs. The median sulcus is very deep. The species *D. spirocauda* is closest in body shape. The new species differs from it in the following characters: 1) absence of pharynx, 2) absence of mucus-secreting cells around the esophagus and beginning of the intestinal branches; the ovary in *D. dimidiatus* sp. n. is biramous, without secondary branchings, while in *D. spirocauda*, there are secondary branchings.

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REVISION OF THE GENUS *DIDYMOCYSTIS* AND VALIDATION OF THE GENUS *DIDYMOSULCUS* GEN. N. (TREMATODA, DIDYMOZOIDAE)

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Summary

After revision of the genus *Didymocystis* Ariola, 1902 all the species with the median stria on the rear part of the body were removed from the genus. They are considered to represent the genus *Didymosulcus* gen. n. The genera *Coeliodidymocystis*, *Didymocystoides* and *Univitellodidymocystis* established by Yamaguti (1970) are reduced to synonyms of the genus *Didymocystis*.